PhD Oral Defense

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Thesis Title

Neural Network Based Methods for Constrained Optimization

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Abstract

This thesis is dedicated to solving several nonlinear constrained optimization problems arising in robust estimation and feature learning. First, two tasks of robust estimation are addressed, including ellipse fitting and elliptic localization. In real-life situations, noise and outliers are unavoidable. The key idea of least squares (LS)-based estimators is to adjust the unknowns to minimize the squared L2-norm of errors between the noisy observations and estimations. Despite the effectiveness of handling Gaussian noise, the performance of the LS-based methods could be greatly degraded when the observed data contains outliers. In this thesis, the tasks of robust estimation are formulated as non-smooth constrained optimization with an L0-norm or L1-norm-based objective function. Afterwards, robust estimators are developed with the use of the Lagrange programming neural network (LPNN). Finally, the feature learning task based on the convolutional neural network (CNN) is studied. The constrained center loss (CCL) is proposed to enhance the discrimination power of deep features. The training objective function of the CCL-based algorithm consists of two terms, namely, the softmax loss and CCL. In the course of training, the CCL-based algorithm utilizes the alternative learning strategy. The first step updates the cluster centers, while the second step updates the connection weights of the feature learning module. Experiments on several commonly used datasets verify the effectiveness of the proposed algorithm.